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(54) Extraction in real time of characteristic points of a television image

(57) A data compression system for a television image has (i) a "space contour extractor" 3 for detecting those points of the image which differ in brightness from spatially-adjacent points, and (ii) a "moving detector" 4 for detecting those points whose brightness has changed in time. Information pertaining to a given point need be transmitted only if the point is detected at both (i) and (ii) (or, alternatively, if it is detected at either (i) or (ii)).

The "space contour extractor" 3 selects a given point if a) that point differs from two adjacent points, or b) if that point differs from one adjacent point and the next point also differs from one adjacent point.

FIG_1

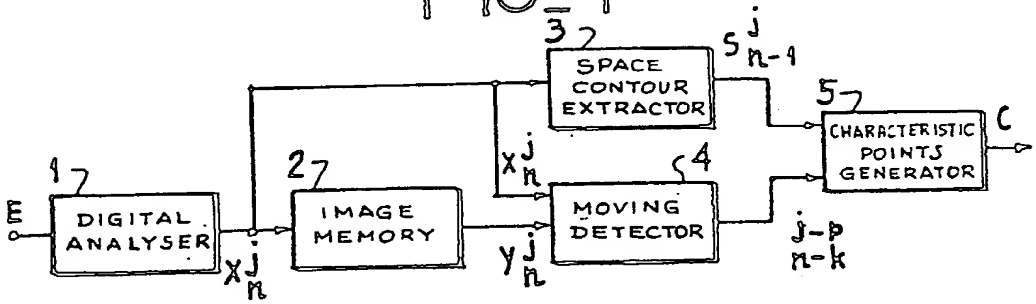

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FIG_1

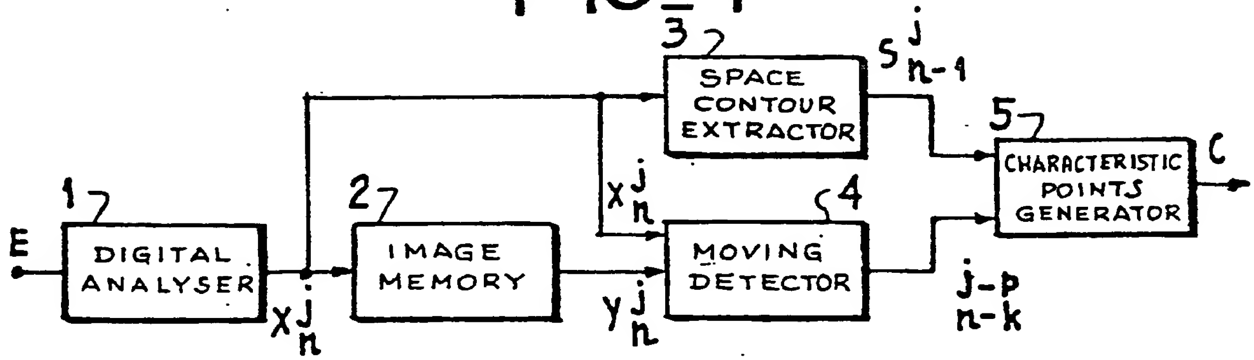

FIG_3

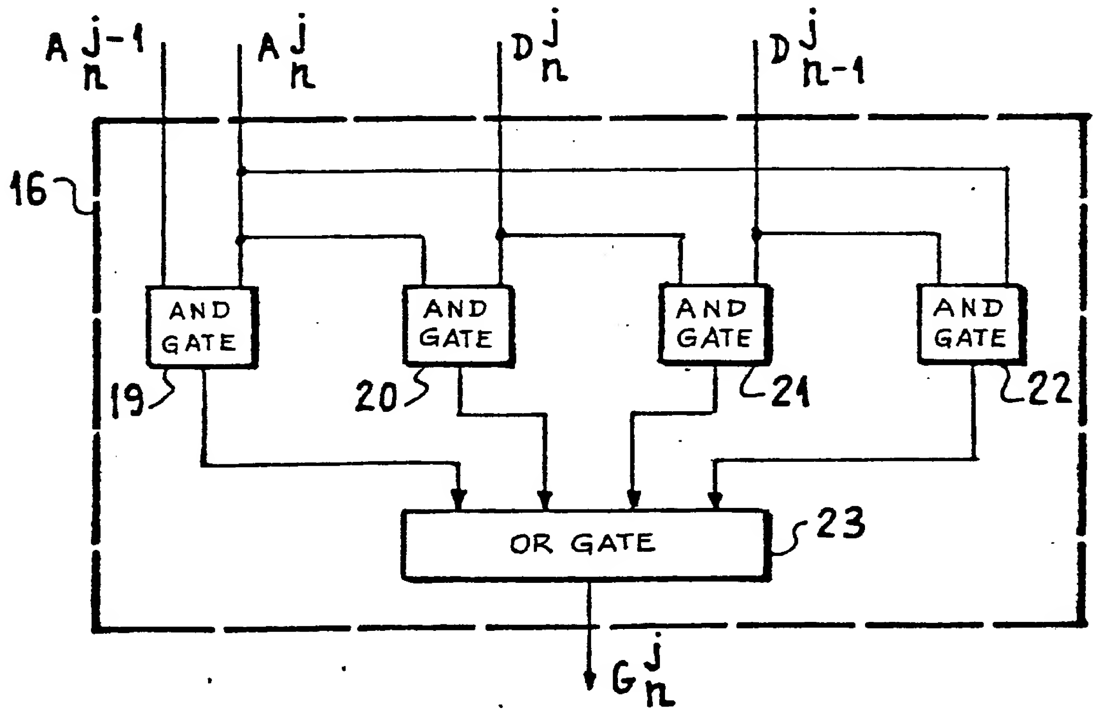

FIG_4

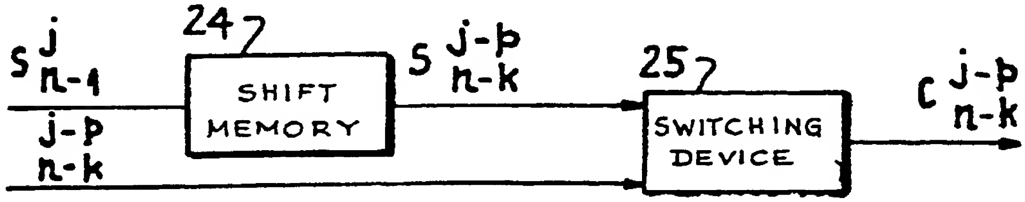

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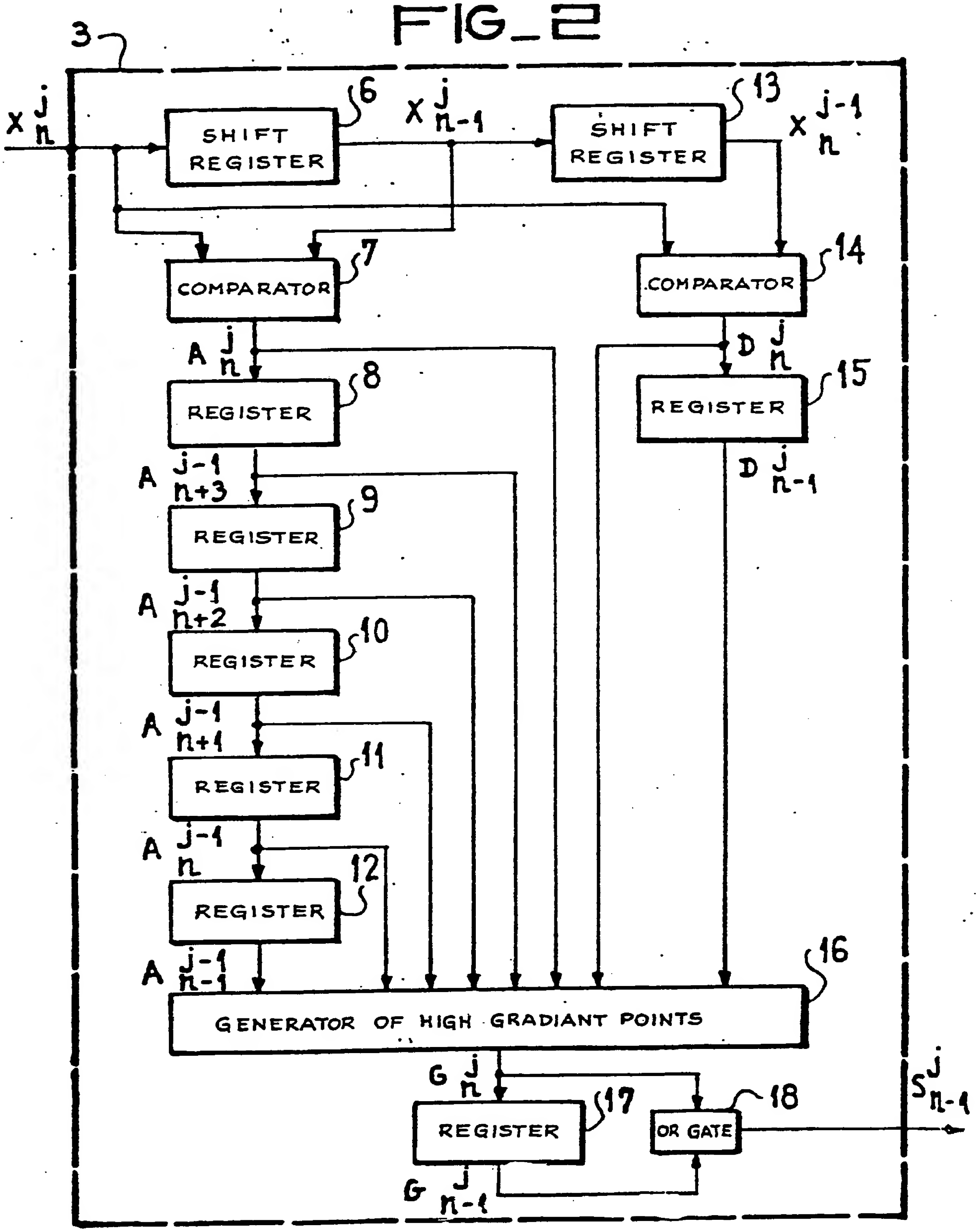
FIG_2



A PROCESS FOR THE EXTRACTION IN REAL TIME OF THE CHARACTERISTIC POINTS OF A TELEVISION IMAGE AND A DEVICE USING THIS PROCESS

The present invention relates to a process for the extraction in real time of the characteristic points of a television image and a device using this process.

By characteristic points of an image are meant the points which, by their brightness and the brightness of the neighbouring points, are sufficient to provide information on the spatial or temporal situation of the image.

These points are situated, for example, on contours surrounding areas of given shade or brightness in the image or are points situated in areas which are moving in the image and undergo brightness modifications between two analyses of successive images.

It can be understood that the knowledge of these points alone is sufficient to provide information both on the contents and the change in the contents of the image. In fact, the knowledge of the points surrounding an image area of given shade or brightness is sufficient to situate this area within the image. In the same way, the knowledge only of the points which undergo brightness variations is sufficient by itself to provide a represantation of the change of the image with time.

The detection of the characteristic points of a television image is of capital importance in the field of television image transmission by telephone line and in the field of image processing because it enables the other points in the image to be ignored and only transmits the characte-

ristic points or processes only these characteristic points. In one case or the other, the image transmission time and the delay required for processing the points in the image are reduced.

Processes and devices are known which enable the number of points to be transmitted or processed in an image to be reduced but the results obtained are not satisfactory when the number of points analyzed in an image is large and the number of grey or shade levels per image point is large. Such processes are completely unusable when the number of levels per image point to be processed reaches 256 different grey or shade levels for example.

It can be understood that, in this example, the number of characteristic points to be extracted is very large.

Extractors of characteristic points are also known which are formed mainly by detectors of moving points inside the image. These detectors, which are perfectly adapted to situations in which the image is continually moving, are unusable in situations in which the image is fixed because, in these cases, no characteristic point is detected.

The purpose of the inventiuon is to obviate these disadvantages by means of a process and a device which enable the number of characteristic points in the image to be taken into account to be considerably reduced for the transmission or processing of television images.

It is and object of the invention to provide a process for the extraction in real time of characteristic points of a television image situated either on the contour of fixed areas in the image or in areas of the image in movement, each area having a given brightness or shade

level, consisting, when the image is fixed, in the steps of, measuring the brightness gradients of each image point in several directions by comparing the difference in brightness of each image point with that of neighbouring points in these directions with at least one predetermined brightness threshold for each direction and selecting each image point when each of the brightness gradients of the point is greater than the predetermined brightness threshold for its direction and/or when at least one of the brightness gradients of the image point to be selected and at least one of the brightness gradients, among the brightness gradients of the neighbouring points, are both greater than the predetermined brightness threshold value corresponding to their measurement direction and/or extracting, when the image is moving, the moving points in moving areas in the image which have undergone brightness variations between two successive image analyses.

It is another object of the invention to provide a device for the extraction in real time of characteristic points in an image transmitted by means of video signals and analyzed along the lines and columns of a matrix of points by a digital analyzer comprising a generator for generating characteristic points of the image connected to the output of the digital analyzer through an extractor for extracting space contours in each image and through a moving detector of each image point.

Other characteristics and advantages of the invention will appear from the description given with reference to the attached drawings, which is given only as an example, and in which :

- figure 1 shows, in the form of a synoptic schematic diagram, the device for the extraction in real time of the image points in accordance

with the invention,

- figure 2 shows the extractor of space contours of the device in accordance with the invention,

- figure 3 shows the generator of points of high gradient in the device in accordance with the invention,

- figure 4 shows the generator of characteristic points of the device in accordance with the invention.

The device shown in figure 1 contains a digital image analyzer 1, which receives at its input E an analogue video signal coming, for example, from a television camera which is not shown, an image memory 2, an extractor of space contours 3, a moving detector 4 and a generator of characteristic points 5. Digital analyzer 1 feeds the input of image memory 2 on the hand and the inputs of space contour extractor 3 and moving detector 4 on the other. Moving detector 4 is also connected by another input to the output of image memory 2. Characteristic point generator 5 has two inputs which are connected to the output of space contour extractor 3 and the output of moving detector 4 respectively. Generator 5 delivers the characteristic points of the image at its output C.

Digital image analyzer 1, memory 2 and moving detector 4 are among the devices known in television technique. For fuller details of their construction reference may usefully be made to the description in French Patent Application n° 2 387 557.

The space contour extractor is shown in figure 2. It contains a shift register 6 connected by its input to the output of digital analyzer 1 and by its output to the first input of a comparator 7 whose second input

is also connected to the output of digital analyzer 1. The output of comparator 7 is connected to the input of a set of shift registers 8 to 12 connected in series. The output of shift register 6 is also connected to the input of a shif register 13. A comparator 14 is connected by one input to the output of shift register 13 and by its other input to the output of digital analyzer 1. The result of the comparison made by comparator 14 is transmitted to the input of a register 15. The respective outputs of registers 8 to 12 and of register 15 as well as those of comparators 7 and 14, are connected to the various inputs of a generator of points with a high brightness gradient 16. The output of the generator of points with a high gradient 16 is connected to the input of a register 17 on the one hand and to the input of an OR gate 18 on the other, the other input of the latter being connected to the output of register 17. As previously, register 17 may be formed by several flip-flops.

An example of a generator of points with a high gradient is shown in figure 3. The generator shown contains a set of AND gates with two inputs (19, 20, 21 and 22) and an OR gate 23 whose inputs are connected to the outputs of AND gates 19 to 22 respectively. The inputs of AND gate 19 are connected to the output of register 11 and of comparator 7. The inputs of AND gate 20 are connected to the output of comparator 7 and of comparator 14. The inputs of AND gate 21 are connected to the output of comparator 14 on the one hand and to the output of register 15 on the other. The inputs of AND gate 22 are connected to the output of register 15 on the one hand and to the output of comparator 7 on the other. The output of OR gate 23 forms the output of the generator of points having a high gradient.

The generator of characteristic points 5 is shown in figure 4. It comprises a shift memory, such as a shift register 24, connected by its input to the output of OR gate 18 of space contour extractor 3 and by its output to the input of a switching device 25. Switching device 25 is connected by a second input to moving detector 4. The output of switching device 25 forms the output of the characteristic point generator.

The device ~~for~~ extraction in real time of characteristic points in a image which has just been described operates as follows. When it is emitted, the video signal coming from the television camera is digitalized by digital analyzer 1. Each video signal is representative of the brightness level of a point P_n^j which is identifiable in the image space inside a matrix of points, which are arranged in lines and columns so that each image point P_n^j can be identified at the intersection of a vertical column n and a horizontal line j of the image space. As a result, each image point P_n^j is characterized by its brightness which is represented by digital analyzer 1 as an electric signal X_n^j, which is applied to the input of image memory 2 on the one hand and to the inputs of space contour extractor 3 and movement detector 4 on the other. Signal X_n^j is recorded in image memory 2 during the length of an image sweep period and is returned at the end of the period in the form of a signal Y_n^j. Hence, signals X_n^j and Y_n^j represent the brightnesses of point P_n^j at different instants separated by an image sweep period. Signal Y_n^j is also applied to the input of moving detector 4.

Contour extractor 3 enables the characteristic points of the image to be extracted which are on each contour around an area of given

shade or brightness in the image, the extractor delivering, from current signal X_n^j which is being analyzed, ~~either~~ a binary signal S_{n-1}^j of logic level 1 when point P_n^j is on a contour or close to this contour, or a signal of logic level 0 when it is far from the contour.

Moving detector 4 delivers a binary signal $MOUV_{n-k}^{j-p}$ of logic level 1 when the brightness of point P analyzed in the incident image being analyzed is modified with respect to the brightness it had in the preceding image, and a binary signal of logic level 0 when the brightness is not modified.

The extraction of the characteristic points in movement by moving detector 4 is done, for images in movement, in the way described in French Patent Application n° 2 387 557, by comparison of the brightness state of a set of points which surround the current point at the state of brightness of the homologous surrounding points in the preceding image.

The extraction by contour extractor 3 is done as described below. Brightness signal X_n^j supplied by digital analyzer 1 is delayed by means of the shift register 6 to give a signal X_{n-1}^j. Shift register 13, whose length is equal to a sweep line, supplies the signal homologous to the preceding line, X_n^{j-1} . Signals X_n^j and X_{n-1}^j are supplied to the input of comparator 7 which delivers a signal A_n^j of logic value 1 when the absolute value of $X_n^j - X_{n-1}^j$ is greater than a prearranged brightness threshold γ .

The binary value 0 or 1 of signal A_n^j represents the brightness gradient of point P_n^j measured along the horizontal direction of the image.

As a result, the measurement made by comparator 7 enables the transitions of points with a high brightness gradient to be detected in the

image columns.

For the transitions of points with a high brightness gradient in the horizontal lines of the image, a measurement similar to the preceding one is made by comparator 14. Shift register 13 retains in its memory brightness signal X_n^{j-1} and this signal is compared with brightness signal S_n^j by comparator 14. Comparator 14 delivers a binary signal D_n^j of logic level 1 when the absolute value of the brightness differences $X_n^j - X_n^{j-1}$ is greater than a certain prearranged threshold μ.

The binary value 0 or 1 of signal D_n^j represents the brightness gradient of point P_n^j measured in the vertical direction of the image.

The measurement thresholds γ and μ can be made adjustable as a function of the type of image observed depending on whether it has highly contrasted or little contrasted areas. In the case of little contrasted television images, corresponding to strongly lit scenes, the threshold value can be adjusted to be small. On the other hand, higher threshold values can be chosen for highly contrasted images with a small number of brightness levels so that certain areas of the image can be made to appear or disappear as required.

In accordance with the way of making the invention, although the brightness gradient measurement is made only in the horizontal and vertical directions of the image, it may be noted that it is possible, without going outside the invention, to make gradient measurements for each point P_n^j in other directions. For this purpose, it is sufficient to measure the brightness differences of the current point with respect to neighbouring points which are not in horizontal or vertical directions with respect to it.

Output signals A_n^j and D_n^j of the two comparators 7 and 14 are delayed through shift registers 8 to 12 on the one hand and 15 on the other.

Each signal coming from comparator 7 is pushed, through shift registers 8 to 12 connected in series, at the rate of a clock, which is not shown, which moves at the image column sampling rate. Register 8, whose length corresponds to a sweep line minus three sampling periods, supplies at its output a delayed signal A_{n+3}^{j-1} when signal A_n^j appears at the input of register 8. Signal A_{n+3}^{j-1} corresponds to the result of the comparison made by comparator 7 between brightness signals X_{n+3}^{j-1} and X_{n+2}^{j-1} of points P_{n+3}^{j-1} and P_{n+2}^{j-1}.

As a result, signal A_{n+3}^{j-1} represents the recorded value of the brightness gradient of point P_{n+3}^{j-1} measured along the horizontal direction of the image. In the same way, registers 9, 10, 11 and 12, whose lengths correspond to a sweep line from with must be subtracted +2, +1, 0 and -1 sampling periods respectively, deliver at their outputs signals representing the recorded values of the brightness gradients, A_{n+2}^{j-1}, A_{n+1}^{j-1}, A_n^{j-1} and A_{n-1}^{j-1}, of points P_{n+2}^{j-1}, P_{n+1}^{j-1}, P_n^{j-1} and P_{n-1}^{j-1} measured along the horizontal direction of the image, when signal A_n^j is delivered by comparator 7.

In similar fashion, register 15 records signal D_{n-1}^j, which represents the brightness gradient value of point P_{n-1}^j, which is measured in the vertical direction of the image by means of comparator 14 and it delivers this signal when signal D_n^j is at its input.

Signals A_n^j and D_n^j/signals A_{n+3}^{j-1}, A_{n+2}^{j-1}, A_n^{j-1} , A_{n-1}^{j-1} and D_{n-1}^j are applied to the inputs of high gradient point generator 16. The purpose of high gradient point generator 16 is to filter the isolated high brightness

gradient points which result, either from noise or from highly textured areas so that they will not be considered as characteristic points of the image. When a point P_n^j is isolated, the brightness gradients, A_{n+3}^{j-1}, A_{n+2}^{j-1}, A_n^{j-1}, A_{n-1}^{j-1} and D_{n-1}^j of neighbouring points P_{n+3}^{j-1}, P_{n+2}^{j-1}, P_n^{j-1}, P_{n-1}^{j-1} and P_{n-1}^j are zero because, in this case, the results of the comparisons of their differences in brightness with respect to the points in their neighbourhoods are less than the prearranged brightness threshold values and μ.

As result, the recording by generator 16 of the brightness gradient values of the neighbouring points, P_{n+3}^{j-1}, P_{n+2}^{j-1}, P_n^{j-1}, P_{n-1}^{j-1} and P_{n-1}^j enables each image point to be selected, to make it characteristic, only when the neighbouring points also have a brightness gradient greater than one of the thresholds, γ or μ considered. The generator of high gradient points 16 shown in figure 3, provides one possible type of filtering by taking into account only the brightness gradients of points P_n^j, P_{n-1}^j and P_n^{j-1} to deliver a signal G_n^j of logic level 1 when the point analyzed P_n^j is a characteristic point of the image. Binary signal G_n^j, delivered by OR gate 23, assumes logic state 1 when the signals A_n^{j-1}, A_n^j, D_n^j and D_{n-1}^j, which represent the brightness gradients of points P_n^{j-1} and P_n^j measured along the horizontal and vertical directions of the image, enable one of the following logic equations to be checked :

$$A_n^{j-1}.A_n^j = 1 ; A_n^j.D_n^j = 1 ; D_n^j.D_{n-1}^j = 1 ; D_{n-1}^j.A_n^j = 1.$$

As a result, the binary state, 0 or 1, of signal G_n^j is determined as a function of the binary state of signals A_n^{j-1}, A_n^j, D_n^j and D_{n-1}^j by the logic equation

$$G_n^j = A_n^j.A_n^{j-1} + D_{n-1}^j.A_n^j + D_n^j.D_{n-1}^j + A_n^j.D_n^j.$$

A characteristic point P_n^j is then selected if it has a brightness gradient A_n^j, measured along the horizontal direction of the image, which is greater than the brightness threshold γ when the neighbouring homologous point P_n^{j-1} in the preceding line also has a brightness gradient, measured along the horizontal direction of the image, which is greater than the brightness threshold value γ.

Point P_n^j is also selected if it has a brightness gradient A_n^j, along the horizontal direction of the image greater than the brightness threshold value γ when the neighbouring point P_{n-1}^j, which precedes it in the same horizontal line, also has a brightness gradient D_{n-1}^j, measured in the vertical direction of the image greater than the brightness threshold value μ.

Point P_n^j is also selected if it has a brightness gradient D_n^j, measured in the vertical direction of the image, which is greater than the brightness threshold μ when point P_{n-1}^j, which precedes it in the same line, also has a brightness gradient D_{n-1}^j, measured in the vertical direction, greater than the threshold μ.

Finally, point P_n^j may also be selected when its brightness gradient, measured in the horizontal and vertical directions of the image, have values greater than the brightness thresholds γ and μ.

Although, for the design of the generator of high gradient points in figure 3, we have limited ourselves to an assembly with 4 masks, which only allows the brightness gradients of points P_n^j, P_{n-1}^j and P_n^{j-1} to be taken into account, it is evident that it is possible to use other masks to take into account, for example, brightness gradients represented by the signals A_{n+3}^{j-1}, A_{n+2}^{j-1} and A_{n+1}^{j-1} of the neighbouring points, P_{n+3}^{j-1}, P_{n+2}^{j-2}, P_{n+1}^{j-1} and P_n^{j-1}

of the preceding line.

Because of the matrix arrangement of the points analyzed, P_n^j, and of the analysis method, which has been explained, the continuous contours of the image areas observed are returned by the generator of high gradient points in discontinuous fashion. These discontinuities appear even more accentuated, in the shape of stairs, for parts of the contours whose slope with respect to the horizontal direction is near to 45°. In particular, this occurs when the intersections of image lines with a contour give points which are not merged with points P_n^j of the matrix arrangement. In this case, as the contour crosses a line at a point between two points, P_{n-1}^j and P_n^j, the generator of high gradient points 16, for the intersection point of the line and the contour, will deliver two signals, G_{n-1}^j and G_{n-1}^j and G_n^j to produce, in this way, a restoration of the contour of the image analyzed in the form of stairs. To correct this disadvantage, register 17 and OR gate 18 are added to generator 16.

Signal G_n^j delivered by generator 16 is applied to the input of register 17 to be delayed for a sampling period. In this way, register 17 presents, at its output, a signal G_{n-1}^j which is delayed by a sampling period with respect to signal G_n^j when signal G_n^j is present at its input. Signals G_{n-1}^j and G_n^j are applied to the inputs of OR circuit 18, which delivers a signal S_{n-1}^j whose logic level is in state 1 when either point P_{n-1}^j or point P_n^j is a characteristic point. When a contour point is at two points, P_{n-1}^j and P_n^j, of the matrix arrangement, this makes it possible to select only the characteristic point P_{n-1}^j because, in this case, signal S_{n-1}^j is in state 1 when the first characteristic point P_{n-1}^j is selected and remains at 1 during the next sampling period corresponding to the delivery of ~~the delivery of~~

the second characteristic point P_n^j.

The data S_{n-1}^j delivered by the output of OR gate 18 are applied to the input of shift register 24 of characteristic point generator 5. Shift memory 24 delays signal S_{n-1}^j by a quantity corresponding to the number of delay lines required and the number of delay points in the line to be synchronized with the corresponding signal delivered by the movement detector. Hence, memory 24 délivers at its output a signal S_{n-k}^{j-p} in which p corresponds to the number of delay lines required and k to the number of delay points in the line. This signal is applied to the input of switching device 25 which also receives the mowing data $MOUV_{n-k}^{j-p}$ coming from moving detector 4. Switching organ 25 delivers a signal C_{n-k}^{j-p} whose level 1 corresponds to a characteristic point and whose level 0 corresponds to a non-characteristic one. Switching organ 25 makes possible a selection from four different operating modes of the device in accordance with the invention.

In the first mode of operation the device of the invention does not take the moving point into account. It may happen that, in a specific application, the points in movement are meaningless, in particular when only fixed images are being processed. The device only considers as characteristic points, points situated on the space contours, these points then being only 1% to 6% of the image points when the threshold values γ and μ represent 10% of the total dynamic which, for an image definition with 256 grey levels, gives values of γ and μ of 25. In this case, the switching device delivers a signal C_{n-k}^{j-p} equivalent to the signal S_{n-k}^{j-p}.

In a second mode of operation the device of the invention does not

take the points in space contours into account. It may happen that, in specific applications, only images formed by points in violent movement with a big space displacement are to be considered and, as a result, the fixed points do not supply much data. In this case, only points in areas in movement are considered as characteristic. In this application, the switching device delivers an output signal C_{n-k}^{j-p} similar to the signal delivered by movement detector 4.

In a third mode of operation, the switching device does a logic OR operation between signal S_{n-k}^{j-p} and the signal coming from movement detector 4. This operating mode is interesting in the case of slow or moderate movements as, in this case, temporal space contours are concerned. Hence, the space contour points will be reinforced by being united with those in the areas in movement.

In the fourth mode of operation switching organ 25 does a logic AND operation between signal S_{n-k}^{j-p} and the signal supplied by moving detector 4. In this case, it is interesting to consider as characteristic only the points in contours which are both space and time ones. This switching mode is fully adapted for the estimation of movements where only these points contain movement data. It will easily be understood that details of the making of switching device 25 do not need to be shown, the making of the AND and OR logic gates required for its operation being within the capabilities of the man skill in the art.

Although the principles of the present invention have been described above with reference to particular examples of production, it must be understood that the description was only given as an exemple and does not limit the scope of the invention.

CLAIMS

1. A process for the extraction in real time of the characteristic points of a television image which are either on the contour of fixed areas in the image or in areas of the image in movement, each area having a given brightness or shade level, the process consisting, when the image is fixed, in the step of, measuring the brightness gradients (A_n^j, D_n^j) of each image point in several directions by comparing the differences in brightness ($X_n^j - X_{n-1}^j$, $X_n^j - X_n^{j-1}$) of each point in the image (P_n^j) with respect to neighbouring points (P_{n-1}^j, P_n^{j-1}) in these directions with at least one prearranged brightness threshold (γ, μ) for each direction and selecting each point of the image when each of the brightness gradients of the point (A_n^j, D_n^j) is greater than the prearranged brightness threshold (γ, μ) for its direction, and/or when at least one of the brightness gradients (A_n^j, D_n^j) of the image point to be selected and at least one brightness gradient (D_{n-1}^j, A_{n-1}^{j-1}, A_n^{j-1}, A_{n+1}^{j-1}, A_{n+2}^{j-1} and A_{n+3}^{j-1}), among the brightness gradients of the neighbouring points, are each greater than the prearranged brightness threshold value corresponding to their direction of measurement and/or, when the image is moving, extracting the moving points in the image in moving areas in the image which have undergone brightness variations (X_n^j, Y_n^j) between two image analyses in succession.

2. A process as in claim 1 wherein the measuring of the brightness gradient (A_n^j) of each point in the (P_n^j) is made in the horizontal direction of the image.

3. A process as in claim 1 wherein the measuring of the brightness gradient (D_n^j) of each point in the image (P_n^j) is made in the vertical direction of the image.

4. A process as claims 1 wherein the selecting of each point in the image (P_n^j) in made when the value of its brightness gradient (A_n^j), measured in the horizontal direction of the image, is greater than a prearranged threshold value (γ) and when the neighbouring point (P_n^{j-1}) in the vertical of the image also has a brightness gradient (A_n^{j-1}), measured in the horizontal direction of the image greater than a prearranged brightness threshold (γ).

5. A process as claim 4 wherein the selecting of each point in the image (P_n^j) is made when the value of its brightness gradient (A_n^j), measured in the horizontal direction of the image, is greater than a prearranged brightness threshold value (γ) and when the neighbouring point (P_{n-1}^j) in the horizontal direction also has a brightness gradient (D_{n-1}^j), measured in the vertical direction, greater than a prearranged threshold value (μ).

6. A process as claim 5 wherein the selecting of each point in the image (P_n^j) is made when the value of its brightness gradient (D_n^j), measured in the vertical direction of the image, is greater than a prearranged brightness threshold (μ) and when the neighbouring point (P_{n-1}^j) in the horizontal direction also has a brightness gradient (D_{n-1}^j) measured in the vertical direction of the image, greater than the prearranged brightness threshold (μ) in this direction.

7. A process as claim 6 wherein the selecting of each point in the image is made when its brightness gradients (A_n^j, D_n^j) measured in the horizontal and vertical directions of the image, have values, greater than the prearranged brightness thresholds (γ, μ) defined for each of these directions.

8. A process as claims 7 wherein the extracting of only one

characteristic point (P^j_{n-1}) is made when two adjacent points (P^j_{n-1}, P^j_n) on the same horizontal line are selected.

9. A process as claim 8 consisting in the step of, taking into account as characteristic points only the fixed characteristic points.

10. A process as claim 8 consisting in the step of, taking into account as characteristic points only the characteristic points in movement.

11. A process as claim 8 consisting in the step of, taking into account as characteristic points only the fixed characteristic points in the image reinforced by the combining of the characteristic points in movement.

12. A process as claim 9 consisting in the step of, taking into account as characteristic points only the points formed by the combination of the fixed characteristic points with the characteristic points in movement.

13. A device for the extraction in real time of the characteristic points of a television image which is transmitted by means of video signals and analyzed along the lines and columns of a matrix of points by a digital analyzer comprising a generator for generating characteristic points of the image connected to the output of the digital analyzer through a space contour extractor for extracting each point in the image and through a moving detector of each image point.

14. A device for the extraction in real time of the points characteristic of an image which is transmitted by means of video signals, as in claim 13 wherein the space contour extractor comprises first comparator connected by its first input to the output of the image

analyzer for receiving the current video signal (X_n^j) and by its second input to the output of a first register in which the preceding video signal (X_{n-1}^j) in the same line as the current video signal is recorded, the first comparator delivering a binary signal of level 1 when the absolute value of the difference between the video signals applied to its inputs is greater than a prearranged threshold, a second comparator connected by one input to the output of the image analyzer for receiving the ~~current~~ video signal (X_n^j), and by a second input to the output of a second register in which the video signal in the preceding line homologous to the current video signal is recorded, the second comparator delivering a binary signal of level 1 when the absolute value of the difference between the video signals applied to its inputs is greater than a certain prearranged threshold ~~a plurality~~ of shift register connected in series, the input of the said plurality being connected to the output of the first comparator, the results of the comparisons made for the points in the preceding line by the first comparator ~~being~~ pushed in serial in these registers, a shift register connected to the output of the second comparator ~~for recording~~ the result of the comparison made by the second comparator and a generator of point having a high gradient connected by its inputs to the outputs of the ~~plurality of~~ shift register ~~and to the shift register for recording the result of the comparison made by the second comparator~~.

15. A device as claim 14 comprising a shift register connected to the output of the generator of the points with a high gradient for recording the point with a high gradient in the preceding column.

16. A device as claim 15 wherein an OR circuit is connected by one of ~~whose~~ inputs to the output of point generator and whose other

output is connected to the output of the shift register for recording the point with a high gradient in the preceding column.

17. A device as claims 13 wherein the generator of points with a high gradient comprises several masks for filtering isolated points with a high brightness gradient.

18. A device as claim 13 wherein the moving detector is connected by one input to the output of the image analyzer and by a second input to the output of an image memory containing the video signal with the same coordinates as the current signal but corresponding to the preceding image.

19. A device as claim 13 wherein the characteristic point generator comprises a shift register connected by its input to the output of the space contour extractor while its output is connected to the first input of a switching device, a second input of the switching device being connected to the output of the moving detector.

20. A process for the extraction in real time of the characteristic points of a television image substantially as hereinbefore described with reference to the accompanying drawings.

21. A device for the extraction in real time of the characteristic points of a television image substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

Amendments to the claims have been filed as follows

1. A process for the selection in real time of the characteristic points of a television image which are on the contour of zones of brightness or shade level of the image, the process consisting in measuring the brightness gradients (A_n^j, D_n^j) of each image point in several directions by comparing the differences in brightness $(X_n^j - X_{n-1}^j, X_n^j - X_n^{j-1})$ of each point in the image (P_n^j) with respect to neighbouring points (P_{n-1}^j, P_n^{j-1}) in these directions with a prearranged and adjustable brightness threshold (δ, μ) for each direction, and selecting a point of the image when at least one of the measured brightness gradients (A_n^j, D_n^j) of the point and at least one brightness gradient among the brightness gradients of the neighbouring points are each greater than the prearranged brightness threshold value corresponding to their direction of measurement.

2. A process according to claim 1 further comprising the step of selecting characteristic points in the image which have undergone brightness variation (X_n^j, Y_n^j) between two successive image analyses.

3. A process as claimed in claim 1 wherein the measuring of the brightness gradient (A_n^j) of each point in the image (P_n^j) is made in the horizontal direction of the image.

4. A process as claimed in claim 1 wherein the measuring of the brightness gradient (D_n^j) of each point in the image (P_n^j) is made in the vertical direction of the image.

5. A process as claimed in claim 1 wherein each point in the image (P_n^j) is further selected when the value of its brightness gradient (A_n^j) measured in the horizontal direction of the image is greater than a prearranged threshold value (S) and when the neighbouring point (P_n^{j-1}) in the vertical of the image

also has a brightness gradient (A_n^{j-1}) measured in the horizontal direction of the image greater than a prearranged brightness threshold (δ).

6. A process as claimed in claim 5 wherein each point in the image (P_n^j) is further selected when the value of its brightness gradient (A_n^j) measured in the horizontal direction of the image is greater than a prearranged brightness threshold value (δ) and when the neighbouring point (P_{n-1}^j) in the horizontal direction also has a brightness gradient (D_{n-1}^j), measured in the vertical direction, greater than a prearranged threshold value (μ).

7. A process as claimed in claim 6 wherein each point in the image (P_n^j) is further selected when the value of its brightness gradient (D_n^j), measured in the vertical direction of the image, is greater than a prearranged brightness threshold (μ) and when the neighbouring point (P_{n-1}^j) in the horizontal direction also has a brightness gradient (D_{n-1}^j) measured in the vertical direction of the image greater than the prearranged brightness threshold (μ) in this direction.

8. A process as claimed in claim 7 wherein the selecting of each point in the image is made when its brightness gradients (A_n^j, D_n^j) measured in the horizontal and vertical directions of the image have values greater than the prearranged brightness thresholds (δ, u) defined for each of these directions.

9. A process as claimed in claim 8 wherein the extracting of only one characteristic point (P_{n-1}^j, P_n^j) is made when two adjacent points (P_{n-1}^j, P_n^j) on the same horizontal line are selected.

10. A device for applying the process as claimed in any one of claims 1 to 9 said device comprising a digital image analyzer for generating digital signals representative of the brightness of points of the image along lines and columns of a matrix of points, a characteristic point generator for generating characteristic points of the image, connected to the output of the digital analyzer through a space contour extractor for selecting points on the contour of zones of brightness or shade level of the image and through a detector of the movement of said image, the space contour extractor ——————————

comprising a first comparator connected by its first input to the output of the digital image analyzer for receiving a video signal indicative of the brightness level of an image point (X_n^j) and by its second input to the output of a first register in which the preceding image point signal (X_{n-1}^j) in the same line as the current video signal is recorded, the first comparator delivering a binary signal of level 1 when the absolute value of the difference between the image point signals applied to its inputs is greater than a first prearranged and adjustable threshold, a second comparator connected by one input to the output of the image analyzer for receiving the current video signal (X_n^j) and by a second input to the output of a second register in which the video signal in the preceding line homologous to the current video signal is recorded, the second comparator delivering a binary signal of level 1 when the absolute value of the difference between the video signals applied to its inputs is greater than a second prearranged and adjustable threshold, a plurality of shift registers connected in series, the input of the said plurality being connected to the output of the first comparator, the results of the comparisons made for the points in the preceding line by the first comparator being

pushed in serial in these registers, a shift register connected to the putput of the second comparator for recording the result of the comparison made by the second comparator and a generator of points having a high gradient connected by its inputs to the outputs of the ——————————

plurality of shift registers and to the shift register for recording the result of the comparison made by the second comparator, and to the output of said first and second comparator for filtering the isolated points with a high brightness gradient so that they will not be considered as characteristic points of the image; the characteristic point generator comprising a shift register connected by its input to the output of the space contour extractor while its output is connected to the first input of a switching device, a second input of the switching device being connected to the output of the detector of movement, the characteristic point generator serving to select a point of the image when at least one of the measured brightness gradients (A_n^j, D_n^j) of the point and at least one brightness gradient among the brightness gradients of the neighbouring points, are each greater than the prearranged brightness threshold value corresponding to their direction of measurement.

11. A device as claimed in claim 10 wherein the space contour extractor comprises a shift register connected to the output of the generator of the points with a high gradient for recording the point with a high gradient in the preceding column.

12 A device as claimed in claim 10 or claim 11 wherein an OR circuit is connected by one of whose inputs to the output of the generator of the points with a high gradient and whose other output is connected to the output of the shift register for recording the point with a high gradient in the preceding column.

13. A device as claimed in claim 10 wherein the generator of points with a high gradient comprises several masks for filtering isolated points with a high brightness gradient.

14. A device as claimed in claim 10 wherein the detector of movement is connected by one input to the output of the image analyzer and by a second input to the output of an image memory containing the video signal with the same coordinates as the current signal but corresponding to the preceding image.

15. A process for the selection in real time of the characteristic points of a television image as claimed in claim 1 and substantially as hereinbefore described with reference to the

accompanying drawings.

16. A device for the selection in real time of the characteristic points of a television image substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

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